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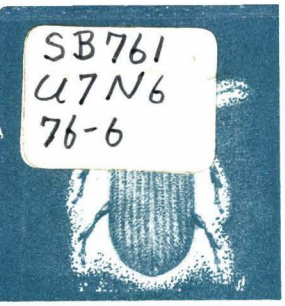

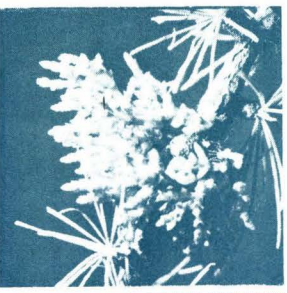

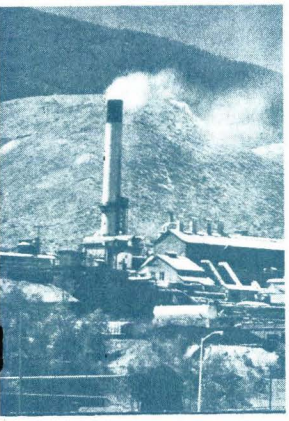

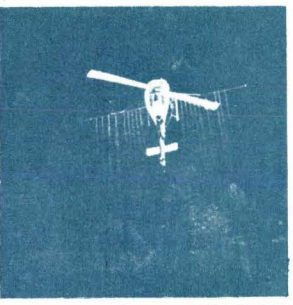

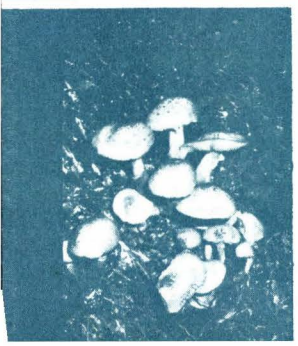

# FOREST ENVIRONMENTAL PROTECTION

USDA · FOREST SERVICE · NORTHERN REGION
State & Private Forestry · Missoula, MT 59801

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## EVALUATION OF MOUNTAIN PINE BEETLE INFESTATIONS-LAP, COOL, LANG, AND CARIBOU CREEK DRAINAGES, YAAK RANGER DISTRICT, KOOTENAI NATIONAL FOREST, MONTANA

By

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## ABSTRACT

Mountain pine beetle reached epidemic levels in the Lap, Cool, Lang, and Caribou Creek drainages in 1974. From 1973 to 1975, approximately 56,282 trees with an estimated volume of 4,365,660 board feet were killed in these areas. An additional 61,721 trees are predicted to be killed in 1976. Currently infested acreage on the Yaak Ranger District equals 5,110 ac. (2,068 ha). This represents 5% of the 118,345 ac. (47,894 ha) risk rated high and given Priority 1 for management treatment. Selective logging to remove infested and susceptible trees is recommended to reduce the epidemic trend.

## INTRODUCTION

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., infestations in the Lap, Cool, Lang, and Caribou Creek drainages, Yaak Ranger District, Kootenai National Forest (Figure 1) developed to epidemic status in 1974. Aerial detection surveys indicate mountain pine beetle infestations began on the Yaak District in 1972 when approximately 125 infested trees occurred along Caribou, Solo Joe, Lap, and Lang Creeks. In 1973, number of infested trees on the District increased to approximately 1,125. In 1974, an epidemic trend was predicted and extensive surveys were conducted in the Solo Joe and Beaver Creek drainages, (McGregor *et al.*, 1975). Epidemic conditions prevailed and during the

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fall of 1975, the Yaak Ranger District initiated operational surveys to determine number of trees infested, volume loss by year, and acreage involved in the Lap, Cool, Lang, and Caribou Creek drainages. The purpose of these surveys was to delineate areas of most severe infestation so salvage logging could be implemented.

## METHODS

Ground surveys were conducted on a total of 1,815 ac. (734 ha) during October and November, 1975. Variable plots (BAF-10 and 20) were established at 5-chain intervals on lines 10 chains apart. Spiegal Relaskops were used to tally trees in each plot. All trees tallied were recorded by species, measured for diameter at breast height (d.b.h.) and total height for volume estimates. Trees were categorized into the following classes:

1. 1975 attack; green or partially faded foliage, brood in cambium, and blue stain present.

2. 1974 attack; red foliage, brood emerged.

3. 1973 or prior attack; majority of needles dropped.

4. Unsuccessful attack or pitchout; brood and blue stain absent.

Survey data were analyzed using a modified R-1 timber sale cruise program.

MOUNTAIN PINE BEETLE HAZARD MAP, YAAK DISTRICT
KOOTENAI NATIONAL FOREST, MONTANA

Priority 1.-- H.T. where LP is dominant seral, stand age is >80y and DBH >7".

Priority 2.--H.T. where LP is dominant seral, stand age is >60 y and DBH >7".

Priority 3.--All H.T., stand age >60y DBH <7".

Current mountain pine beetle infestations.

Survey areas.

-3-

## RESULTS

Stand descriptions.--Habitat types and species composition of each area surveyed are listed in Table 1.

Table 1.--Habitat types and species composition, Lap, Cool, Lang, and Caribou Creek drainages Yaak District, Kootenai National Forest, 1975.

| Area | Habitat Types 1/ | Percent species composition | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Pinus contorta* | *Larix occidentalis* | *Picea engelmanni* | *Thuja plicata* | *Pinus monticola* | *Pseudotsuga menziesii* | *Tsuga heterophylla* | *Abies lasiocarpa* | *Abies grandis* | *Populus angustifolia* |
| Lap Creek | WRC & WH/Clun | 60.7 | 22.3 | 6.0 | 4.7 | 2.3 | 1.6 | 1.2 | 0.9 | 0.02 | 0.09 |
| Cool, Lang Creeks | WH/Clun | 32.3 | 39.7 | 3.5 | 5.7 | 12.4 | 3.9 | 1.2 | 0.9 | 0.1 | 0 |
| Caribou Creek | AF/Clun | 40.5 | 47.8 | 4.8 | 1.6 | 0.3 | 4.2 | 0 | 0.7 | 0.08 | 0 |

1/ Pfister *et al.*, 1974.

Infestation intensities.--The mountain pine beetle infestation in Lap Creek drainage decreased from 4,883 infested trees in 1973 to 2,721 trees in 1974, then increased to 9,309 trees in 1975 (Table 2). This shows a 1:0.6 ratio of old to newly attacked trees from 1973 to 1974, and a 1:3.4 buildup ratio from 1974 to 1975. A total of 16,913 trees with an estimated volume of 1,866,317 board feet have been killed during the 3-year period from 1973 to 1975. Infested trees averaged 10 in. (25 cm) d.b.h. over the period, range from 6 to 19 in. (15 to 23 cm) d.b.h.

Table 2.--Tree and volume loss estimates caused by mountain pine beetle, Lap Creek drainage, Yaak District, Kootenai National Forest, 1973-75.

| Year | Number of lodgepole pine killed | | Volume loss (bd. ft.) | | Avg. d.b.h. |
|---|---|---|---|---|---|
| | Per acre | Total | Per acre | Total | |
| 1975 | 12.1 | 9,309 | 1,570 | 1,208,652 | 11 |
| 1974 | 3.5 | 2,721 | 374 | 287,759 | 8 |
| 1973 | 6.3 | 4,883 | 480 | 369,666 | 11 |
| Total or avg. | 7.3 | 16,913 | 808 | 1,866,077 | 10 |

In 1973, 51.7% of the trees killed were 12 in. (30 cm) d.b.h. and larger; 60.0% were 12 in. (30 cm) d.b.h. and larger in 1974; and 59.0% were 12 in. (30 cm) d.b.h. and larger in 1975 (Table 3). Eighteen percent of the residual lodgepole pine stand is 12 in. (30 cm) d.b.h. and larger.

Table 3.--Percent infested trees by diameter class, Lap Creek drainage, Yaak District, Kootenai National Forest, 1973-75.

| Percent by year | D.b.h. size class (in inches) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 18+ |
| 1975 | 0 | 0 | 1.5 | 1.5 | 7.5 | 15.0 | 15.0 | 15.0 | 13.0 | 13.0 | 10.0 | 5.0 | 0.5 | 0.5 | 2.0 |
| 1974 | 0 | 2.0 | 0 | 6.1 | 6.1 | 14.3 | 10.2 | 26.5 | 10.2 | 16.3 | 4.0 | 4.0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 2.4 | 5.9 | 10.6 | 16.5 | 12.9 | 14.1 | 18.8 | 7.0 | 4.7 | 4.7 | 2.4 | 0 | 0 |

The Cool-Lang Creek infestation decreased from 3,335 infested trees in 1973 to 2,113 trees in 1974, then increased to 6,704 trees in 1975 (Table 4). This indicates a 1:0.6 buildup ratio of old to newly attacked trees from 1973 to 1974, and a 1:3.17 ratio from 1974 to 1975. A total of 12,152 trees with an estimated volume of 1,512,321 board feet were killed from 1973 to 1975. Infested trees averaged 11 in. (28 cm) d.b.h., range from 8 to 16 in. (20 to 41 cm) d.b.h.

Table 4.--Tree and volume loss estimates caused by mountain pine beetle, Cool-Lang Creek drainages, Yaak District, Kootenai National Forest, 1973-1975.

| Year | Number of lodgepole pine killed | | Volume loss (bd. ft.) | | Avg. d.b.h. |
|---|---|---|---|---|---|
| | Per acre | Total | Per acre | Total | |
| 1975 | 8.6 | 6,704 | 1,211 | 949,689 | 12 |
| 1974 | 2.7 | 2,113 | 280 | 219,142 | 11 |
| 1973 | 4.3 | 3,335 | 438 | 343,490 | 12 |
| Total or avg. | 5.2 | 12,152 | 643 | 1,512,321 | 11 |

In 1973, 66.6% of the trees killed were 12 in. (30 cm) d.b.h. and larger; 57.1% were 12 in. (30 cm) d.b.h. and larger in 1974; and 68.1% were 12 in. (30 cm) d.b.h. and larger in 1975 (Table 5). In the residual green stand 27.6% of the lodgepole pine are 12 in. (30 cm) d.b.h. and larger.

Table 5.--Percent infested trees by diameter class, Cool-Lang Creek drainages, Yaak District, Kootenai National Forest, 1973-75.

| Percent by year | D.b.h. size class (in inches) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 18+ |
| 1975 | 0 | 0 | 0 | 0 | 6.8 | 11.4 | 13.6 | 13.6 | 25.0 | 18.2 | 9.1 | 2.2 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 7.1 | 7.1 | 7.1 | 21.4 | 7.1 | 35.7 | 14.3 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 11.1 | 11.1 | 11.1 | 11.1 | 33.3 | 14.8 | 7.4 | 0 | 0 | 0 | 0 |

Infestation in Caribou Creek drainage decreased from 2,416 infested trees in 1973 to 2,012 trees in 1974, then increased to 4,171 trees in 1975 (Table 6). This indicates at 1:0.8 buildup ratio of old to newly attacked trees from 1973 to 1974 and a 1:2.07 ratio from 1974 to 1975. A total of 8,599 trees with an estimated volume of 987,022 board feet were killed during the period 1973-75. Infested trees averaged 11 in. (28 cm) d.b.h., range from 7 to 18 in. (18 to 46 cm) d.b.h.

Table 6.--Tree and volume loss estimates caused by mountain pine beetle, Caribou Creek drainage, Yaak District, Kootenai National Forest, 1973-75.

| Year | Number of lodgepole pine killed | | Volume loss (bd. ft.) | | Avg. d.b.h. |
|---|---|---|---|---|---|
| | Per acre | Total | Per acre | Total | |
| 1975 | 6.3 | 4,171 | 777 | 511,003 | 11 |
| 1974 | 3.1 | 2,012 | 367 | 241,391 | 12 |
| 1973 | 3.7 | 2,416 | 357 | 234,628 | 11 |
| Total or avg. | 4.4 | 8,599 | 500 | 987,022 | 11 |

In 1973, 57.9% of the trees killed were 12 in. (30 cm) d.b.h. and larger; 61.9% were 12 in. (30 cm) d.b.h. and larger in 1974; and 62.6% were 12 in. (30 cm) d.b.h. and larger in 1975 (Table 7). In the residual green stand, 15.2% of the lodgepole pine are 12 in. (30 cm) d.b.h. and larger.

Table 7.--Percent infested trees by diameter class, Caribou Creek drainage, Yaak District, Kootenai National Forest, 1973-75.

| Percent by year | D.b.h. size class (in inches) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 18+ |
| 1975 | 0 | 0 | 0 | 2.3 | 13.9 | 11.6 | 9.3 | 13.9 | 11.6 | 16.3 | 6.9 | 4.7 | 6.9 | 2.3 | 0 |
| 1974 | 0 | 0 | 0 | 4.8 | 9.5 | 9.5 | 14.3 | 19.0 | 0 | 28.6 | 4.8 | 9.5 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 5.3 | 10.5 | 0 | 15.8 | 10.5 | 21.1 | 15.8 | 10.5 | 0 | 10.5 | 0 | 0 | 0 |

## DISCUSSION

The mountain pine beetle infestation on the Yaak Ranger District began in 1972 and more than doubled in intensity by 1975. In the areas surveyed in 1975, average number of infested trees per ac. (0.4 ha) increased from 4.7 in 1973 to 9.0 in 1975. Buildup ratio of old to newly attacked trees for the combined areas was 1:0.64 from 1973 to 1974, and 1:2.95 from 1974 to 1975. Diameters of infested trees averaged 11 in. (28 cm) through the period.

Data from past epidemic infestations indicate that certain factors such as phloem thickness, tree diameter, stand density, age, habitat type, and weather conditions directly influence stand susceptibility to mountain pine beetle infestation (Cole 1973; Safranyik *et al.* 1974). Safranyik *et al.* (1974) used these factors as a basis for hazard rating lodgepole pine stands in British Columbia. A map extending this concept was prepared by the Kootenai National Forest in 1975 (Figure 1). Hazard ratings were prepared for Forest areas supporting significant lodgepole pine components greater than or equal to 60 years. 1/ Management priorities were subsequently assigned to lodgepole pine stands as follows:

Priority 1. Habitat type where lodgepole pine is dominant seral, stand age is greater than 80 years, and mean tree diameter is greater than 7 in. (18 cm) d.b.h.

1/ Pers. comm. (9/26/75) with John R. Naumann, silviculturist, Kootenai National Forest.

Priority 2. Habitat type where lodgepole pine is dominant seral, stand age is greater than 60 years, and mean tree diameter is greater than 7 in. (18 cm) d.b.h.

Priority 3. All habitat types, stand age greater than 60 years, and mean tree diameter less than 7 in. (18 cm) d.b.h.

On the Yaak Ranger District, approximately 118,345 ac. (47,894 ha) were categorized high risk for mountain pine beetle infestation and given first priority for management. An additional 2,740 ac. (1,108 ha) were categorized Priority 2, and 2,440 ac. (987 ha) Priority 3. Currently, there are 5,110 ac. (2,068 ha) infested with mountain pine beetle within the boundaries of the Priority 1 area on the Yaak District. This accounts for 5% of the total area and indicates that 95% remains high risk.

Using buildup ratios for each of the survey areas on the Yaak District, current and predicted tree losses can be further elucidated. Based on Baker's (1968) formula $Y = y + bx$, where:

$Y$ = the potential cumulative number of trees killed predicted through next year.

$y$ = cumulative number of trees killed through this year.

$x$ = number of trees killed this year.

$x_1$ = number of trees killed last year.

$b = \frac{x}{x_1}$

it is predicted that 31,836 trees will be killed in the Lap Creek drainage in 1976, 21,251 trees are predicted to be killed in the Cool-Lang Creek drainages, and 8,634 trees in the Caribou Creek drainage.

Some investigators (Amman and Baker, 1972) have concluded that the proportion of other tree species would have to be considerably more than 36% in the elevational zone of optimal beetle development for lodgepole pine in a mixed species forest to be less susceptible to mountain pine beetle damage. In the Cool-Lang and Caribou Creek drainages, 60% or more of the stands are composed of species other than lodgepole pine (Table 1), however, this greater mixed species composition is not expected to alter the course of the outbreak. The large percentage of mature (56% $\geq$ 100 ft.) western larch which occurs in these areas are, in fact, dominating the smaller (12% $\geq$ 100 ft.) lodgepole pine and probably contributing to tree stress resulting in greater susceptibility to mountain pine beetle attack.

Sufficient acreage of high risk (Priority 1) lodgepole pine (95% of 118,345 ac.) (47,894 ha) exists on the Yaak District to continue the present mountain pine beetle infestation at epidemic level for several years.

## RECOMMENDATIONS

Several management alternatives are currently available for dealing with mountain pine beetle infestations. These are:

1. Do nothing.

2. Apply direct controls.

    a. Fell and burn infested trees.

    b. Salvage log infested trees.

3. Apply silvicultural practices.

    a. Selectively log high-risk rated areas.

    b. Selectively log to remove lodgepole pine component and convert to desired crop trees of mixed species.

In the event that no controls are exercised, it is unlikely that the infestations will decline of their own accord. With an area of 118,345 ac. (47,894 ha) rated high risk on the Yaak District and only 5% of it currently infested, the risk of having the remaining 95% infested, if no controls are exercised, is high.

Applied suppression by felling and burning or salvage logging infested trees may serve as holding actions; however, they do not lessen overall stand susceptibility. For example, on the Yaak District, the remaining 113,235 uninfested acres (45,826 ha) rated Priority 1 would remain susceptible following application of any currently available direct control technique.

By selectively logging currently infested drainages and high-risk rated areas, stand structures could be altered to favor tree growth and discourage continuation of the mountain pine beetle epidemic. Selective logging could be conducted to remove infested trees and generator trees (i.e., 80- to 100-year-old trees greater than or equal to 10 in. (25 cm) d.b.h., with phloem thickness greater than or equal to 0.10 inch) or to convert to a greater mixed tree species stand.

It is our recommendation that planned harvesting strategies, employing selective logging practices, be considered to reduce the infestation to endemic status and reduce stand susceptibility on the Yaak District.

In the Lap Creek drainage, where more than 60% of the stand is lodgepole pine, selective logging of infested and generator trees is recommended. In the Cool, Lang, and Caribou Creek drainages where mixed species composition is greater than 50%, the option of converting to desired crop trees of mixed species should be explored. For all other areas on the Yaak Ranger District which have been rated Priority 1, it is recommended that additional management plans be initiated. According to Safranyik *et al.*, (1974) the setting of rotation age and projected wood requirements should take into account the chance of mountain pine beetle infestation and the resulting severe depletion. In areas of high hazard, gains made by allowing longer rotations are probably offset by losses to the beetle. Priority cutting should be given older stands with large diameter trees and harvest should not be delayed beyond the age when current and mean annual increment are equal for the stand.

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